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RESEARCH ARTICLE

New data on the distribution of *Cucujus cinnaberinus* in western Romania

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Abstract

The species *Cucujus cinnaberinus* is protected under EU Council Directive 92/43/EEC, Annexes II and IV, as well as under the Bern Convention, Annex II. Probably because it lives hidden under the bark of dead trees *Cucujus cinnaberinus* is less known in many countries. It has been assessed as Near Threatened at the European and global levels by the IUCN Red List. At the European level, 453 Natura 2000 sites have been designated for the conservation of the species in 18 EU Member States, of which Hungary accounts for 31.56% of the designated areas. In Romania, even though wooded areas cover almost 28% of the country's territory, in the absence of historical data, the species is protected in only 8 Natura 2000 sites, all of them located along the Carpathian arc with one exception. Following the studies carried out in the last years in the western and southwestern part of Romania we have identified new locations where the species is present both in protected areas and in areas that may become protected in the future. We have followed the habitat conditions in which the species thrives and its conservation needs. This research significantly contributes to understanding the distribution of *C. cinnaberinus* in Romania, with the new findings representing an initial step toward the species' conservation in new areas.

Keywords

Cucujus cinnaberinus, distribution, inventory, conservation, Natura 2000.

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Introduction

The genus *Cucujus* Fabricius, 1775 (Coleoptera, Cucujidae) is represented by xylophagous beetles with a flattened body, that live under the bark of dead or dying wood. The genus comprises ten species (Wegrzynowicz 2007; Horák et al. 2009), distributed in Eurasia and North America, to which a new Mediterranean species has recently been added, probably endemic to Calabria (Italy) (Bonacci et al. 2012).

Among these, *Cucujus cinnaberinus* is an exclusively European species, *Cucujus haematodes* is Eurasian species, while the other seven are Asian species. *C. clavipes* Fabricius, 1781 has a North American distribution. *C. siculus* Pic, 1894 from Sicily and Venice (Italy) is a synonym of *C. clavipes* (Ratti 1986, 2000), and the presence of the species in Europe is due to accidental introduction. Both native European species are present in Romania. The two species are easily differentiated by the completely red pronotum and mandibles, except for the tips which are black in *C. haematodes*, compared to completely black mandibles and a red pronotum with black lateral margins in *C. cinnaberinus*. *C. haematodes* is much rarer than *C. cinnaberinus*, a fact mentioned by Reitter (Reitter 1911) and is even one of the rarest species in Europe (Horák et al. 2009). However, it is not protected within the Natura 2000 Network, but it is assessed as Endangered by the IUCN Red List (Horák et al. 2010) and considered extinct in Estonia, Finland, Germany, Greece (mainland), Italy (mainland), Norway. Its altitudinal distribution range is limited to the montane and submontane areas. *C. cinnaberinus* has a wider distribution range, being present from the plains to the alpine zone. *C. cinnaberinus* is assessed as Near Threatened by the IUCN Red List (Nieto et al. 2010), but it is protected by Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora - consolidated version 01/01/2007, Annex II, IV and by the Convention on the Conservation of European Wildlife and Natural Habitats. The purpose of this work is to increase the level of knowledge about the distribution and habitat characteristics of the species, mainly in the western part of Romania.

Materials and methods

The species distribution analysis examines the historical and recent records of the species within Romania. We have included our observations made during the period 2018–2023, both within the Natura 2000 protected areas and outside of them, in areas with potential for inclusion in the protected area network or consideration as ecological corridors. Besides distribution, we also present data regarding the tree species in which the species was found, microhabitat conditions, calendar dates, altitude, assessments of habitat conservation status, and recommendations for species conservation in the studied area. We examined dead wood in transects ranging from 500 to 1000 m. The transects were conducted in forest habitats, inspecting the trunks of wood stored in the forest during logging operations. Additionally, isolated trees,

regardless of their size, that were standing dead or fallen, and at various stages of decomposition, were also examined. The investigations were carried out in the western and southwestern counties of Romania: Caraș-Severin, Timiș, Hunedoara, Arad and Bihor. We recorded the locations of the observations using GPS coordinates and altitude, as well as notes on the tree species on which the recordings were made, the size of the trunks, and the habitat conditions in which they were found. In addition, for both the studied area and the rest of Romania, we updated the records found in the databases, as well as those mentioned and confirmed through public images and discussions on social media, which bring together both amateur and specialist entomologists.

Results and discussions

Presumably, due to its cryptic lifestyle, dwelling beneath the bark of decaying trees, the distribution of the species *C. cinnaberinus* remains relatively understudied in numerous countries. In recent years, due to the species' protective status, entomologists have focused more than before on surveying its characteristic habitats. At the European level, 453 Natura 2000 sites have been designated for the conservation of the species in 18 EU Member States, of which Hungary accounts for 31.56% of the designated areas. In Romania, even though wooded areas cover almost 28% of the country's territory, in the absence of historical data, the species is protected in only 8 Natura 2000 sites, all of them located along the Carpathian arc with one exception. The species has been reported in Romania only in the alpine and continental biogeographical regions. In that case, we propose for Romania to include the Pannonian biogeographical region in the reports under Article 17 of the Habitats Directive and to protect the species in Natura 2000 areas where it has not been reported so far.

Historical data

The historical records in the specialized literature and museum collections are quite scarce. Petri (1912) mentioned *C. cinnaberinus* Scop. on the outskirts of Sighișoara towards the border with the village of Albești (in April under the bark of oak), Borsec, Reghin, Rodna Mountains, Măieruș (on May 10), Tușnad (on September 11 under the bark of birch), Răstolița, and *C. haematodes* Er. from Tușnad (under the bark of fir) and Postăvarul Mt (in June). These records were taken from Bielz, Deubel and Müller. Worell (1951) reported *C. cinnaberinus* from Măgura Mt (May, 1925). In the Karl Petri collection (Sibiu), there is one specimen of *C. cinnaberinus* from Caraș-Severin, one from Sighișoara, and one from Măgura Cisnădiei (Bebeșelea and Tăușan 2016). In the collection of *Grigore Antipa* Museum of Natural History (Bucharest) there is a specimen from Gura-Văii, Mehedinți County (May 3, 1962) and in the *Arion-Panin*

entomological collection of the Research-Development Institute for Plant Protection, there is a specimen from Sinaia (August 19, 1945) (Kurzeluk 2021).

Natura 2000 Network

Out of the 435 Natura 2000 sites designated in Romania so far, *C. cinnaberinus* is protected only in 9 sites: ROSAC0013 Bucegi; ROSAC0019 Călimani-Gurghiu, ROSAC0032 Cheile Rudăriei, ROSAC0036 Cheile Vârghișului, ROSAC0063 Defileul Jiului, ROSAC0069 Domogled-Valea Cernei, ROSAC0125 Munții Rodnei, ROSAC0135 Pădurea Bârnova-Repedea, ROSAC0137 Pădurea Bogății. In the western part of Romania, the management of *C. cinnaberinus* protection only covers the southwestern extremity through two protected areas (Fig. 1).

Recent published data:

Lately, scientific research and studies for drafting the management plans of the Natura 2000 areas reveal a widespread distribution of the species within Romania's territory:

- larva: Meseș Mts, Huta, 46.99394°N, 22.92883°E, beech forest, from beneath bark, 21–23.05.2014 (Merkl et al. 2016);

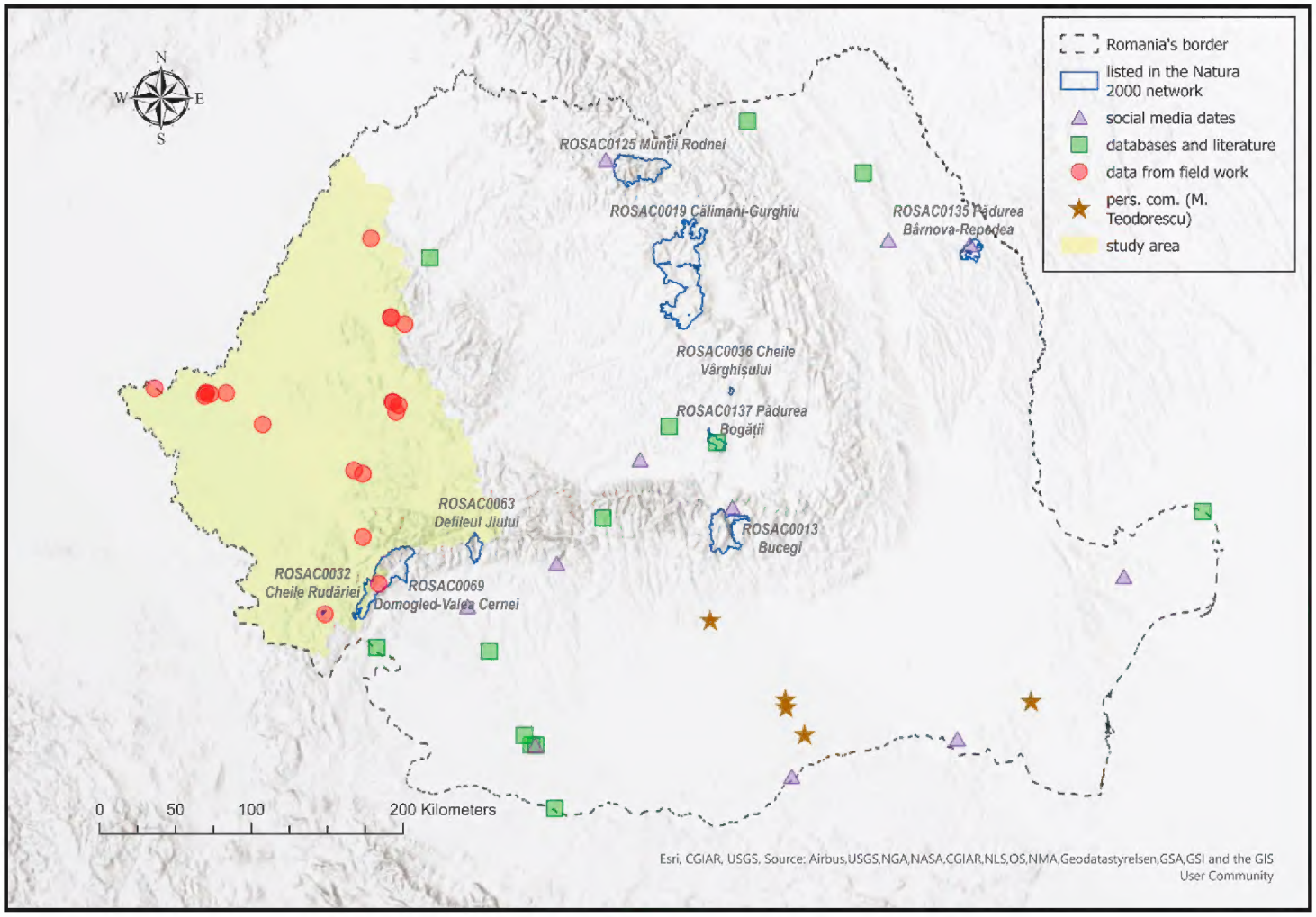

Figure 1. Distribution of *Cucujus cinnaberinus* in Romania.

- imago: Natural Reserve Voievodeasa forest, 47.812–47.826°N; 25.685–25.705°E (Olenici et al. 2021);
- larvae: ROSAC0137 Pădurea Bogății, 45.907575°N, 25.412911°E, in forest with beech trees (dominant species), hornbeam, oak and poplar (Lotrean et al. 2018);
- imago: ROSAC0122 Munții Făgăraș, Boișoara Forest (5–10.05.2012) in much decayed bark of aspen, *Populus tremula* trees with the fungi *Aspergillus, Trichoderma, Ceratocystis* (Walentowski et al. 2013);
- ROSAC0357 Porumbeni, 46.0061638°N, 25.0100805°E (Management plan, 2020), new species, not listed yet in the standard form;
- larvae: ROSAC0045 Coridorul Jiului, Bratovoești 44.10204°N, 23.90496°E, 22.05.2022; Sărata 43.72548889°N, 24.06655156°E, 27.08.2022; Poaina 44.6603138°N, 23.509626°E, 28.08.2022; Foișor 44.10512246°N, 23.8699246°E, 29.08.2022; Calopăr 44.1619357°N, 23.8093891°E, 15.09.2022 (Prunar et al. 2022)

Database:

- imago: Iași County, Bârnova forest, 12.11.2011, under beech bark (Manci C., in www.entomologiitaliani.net/forum);
- ROSAC0135 Pădurea Bârnova-Repedea (Management plan, 2016);
- larva: Iași, 04.03.2017 (Manci C., in http://insects.nature4stock.com);
- larva: Iași County, 21.02.2022 (Manci C., in http://insects.nature4stock.com);
- larva: Neamț County, 06.03.2023 (Manci C., in http://insects.nature4stock.com);
- imago: Iași County, Deleni, 47.505924°N, 26.720537°E, 09.09.2021, (Hanceanu L., in www.inaturalist.org)
- imago: Tulcea County, C. A. Rosetti 45.401625°N, 29.55601°E, 16.02.2021, (Boscain L., in www.inaturalist.org)

Facebook (Insects of Romania and Europe group):

- imago: Brașov County, 24.05.2018 and 20.05.2022 (Dragomir I.); Olteț, 09.10.2018 (Negrea E. G.);
- imago/larvae: Brașov County, Predeal (Trei Brazi), 15.02.2022 (Teodorescu M.);
- imago: Constanța County, Ostrov, 15.11.2011 (Vintila A.);
- imago: Gorj County, 12.08.2023 (Chiper C.);
- imago: Giurgiu County, 27.02.2021 (Aurelian M.), 30.10.2021, 31.12.2021 (Teodorescu M.);
- imago: Iași County, Pârcovaci, Hârlău, 04.05.2021, (Hanceanu L.);
- imago: Rodna Mountains National Park 15.06.2018 (Iusan C.);
- imago: Tulcea County, Dealurile Agighiolului 11.12.2020 (Stanciu C. R.);
- larvae: Arad County, 20.03.2021, 18.09.2021 (Pintilioaie A.);
- larvae: Giurgiu County, 30.10.2021 (Teodorescu M.);

- larva: Iași County, Miclauseni, 27.03.2021 (Olariu T.), Bârnova, 25.11.2020, Pârcovaci, Hârlău, 28.11.2020 (Hanceanu L.);
- larvae: Vâlcea County, Pietreni, 14.03.2020, 24.12.2020 (Țicu S.);
- pupa: Domogled-Valea Cernei National Park, 25.08.2014 (Manci O.).

Personal communication (M. Teodorescu):

- Giurgiu County, Comana, 25–28.10.2024, 44.166275°N, 26.124647°E
- Ilfov County, near Dumitrana, February–April 2020, 44.330703°N, 25.973314°E, in the town of Bragadiru, 2022, 44.376250°N, 25.970305°E
- Dambovita County, near Targoviste, 2022, 44.853613°N, 25.348560°E
- Constamta County, near Cernavoda, 2022, 44.322581°N, 28.018483°E

Our records in western Romania

In the following records, observations of larvae or/and imagos of *C. cinnaberinus* in various locations within Romania are detailed.

Timiș County

- Charlottenburg, 45.970712°N, 21.526636°E, 142 m., 09.08.2020, larvae found under the bark of *Tilia* sp. logs stored in the clearing. There are hill slopes with oak-hornbeam forests containing species such as *Quercus robur*, *Q frainetto*, *Acer campestre*, *Robinia pseudacacia*, *Tilia* sp. and alongside streams with *Fraxinus* sp., *Acer platanoides*. Forest habitats between Charlottenburg, Bogda and Buzad also shelter other Natura 2000 species, having been identified *Euphydryas maturna*, *Lucanus cervus* and *Cerambyx cerdo*.
- Luncanii de Jos, 45.716394°N, 22.326655°E, 393 m., 17.11.2020, larvae found under the bark of a dead pine and in ROSAC0355 Podișul Lipovei - Poiana Ruscă, larvae, 45.697870°N, 22.403909°E, 235 m., 18.11.2020, under the bark of a fallen spruce trunk on the ground. In the investigated area, the dominant vegetation consists of beech forests. In the absence of dead wood from species with thick bark in shaded and humid places, the *C. cinnaberinus* can also be found in resinous species found in small areas and in the trees bordering the valley streams.

Caraș-Severin County

- Eftimie Murgu, ROSAC0032 Cheile Rudăriei, 44.854563°N, 22.118391°E, 329 m., 19.08.2020, larvae found under the bark of a decaying ash trunk on the ground. Previously, the imago was found in the dead wood of a willow tree located on the bank of the river (Prunar et al. 2014). We managed to prove the presence of the species only in the lower part along the valley.

- Țațu, ROSAC006 Domogled - Valea Cernei, 45.047886°N, 22.564995°E, 531 m., 21.11.2020, larvae in black elder wood, beech forest on the Topenia Valley (Fig. 2). We did not find *C. cinnaberinus* on beech logs, the dominant forest species. However, the presence of the beetle is most likely ensured by the woody essences such as *Robinia pseudoacacia*, *Populus* sp, *Ulmus* sp., *Sambucus nigra*, etc., that border the forest roads, as well as by isolated trees or clusters of conifers.
- Vârciorova, ROSAC0126 Munții Țarcu, 45.322714°N, 22.418176°E, 631 m., 22.11.2020, larvae on a standing dead beech tree with a small diameter, less than 30 years old and with nearby conifer trees.

Figure 2. Larva of *Cucujus cinnaberinus* under the bark of black elder, *Sambucus nigra*, in Țațu (foto Prunar F.)

Hunedoara County

- Visca, ROSAC0325 Munții Metaliferi, 46.112719°N, 22.692066°E, 582 m., 11.10.2020, larvae under oak bark; 46.071349°N, 22.673163°E 12.06.2021, larvae on a common walnut log at the edge of the county road.
- Birtin, ROSAC0325 Munții Metaliferi, 46.130740°N, 22.640995°E, 228 m., 12.06.2021, larvae on elm logs stored at the valley's edge.
- Lunca, ROSAC0325 Munții Metaliferi, 46.129376°N, 22.641578°E, 228 m., 12.06.2021, larvae on elm wood.

ROSAC0325 Munții Metaliferi is a protected area where the hardwood forests crisscrossed by numerous valleys cover over 83% of the site, making it an important area for the protection and conservation of the *C. cinnaberinus* species.

Bihor County

- Budureasa, ROSAC0002 Apuseni, 46.595959°N, 22.722498°E, 1270 m., 29.11.2020, imago under bark of standing dead conifer trunk. On the high area of Padeș peak and beyond, the spruce forests are well represented, where wind-felled trees are frequently encountered. Keeping the fallen trunks in the forest has favourable effects on the density of the *C. cinnaberinus* population in the site.
- Boga, ROSAC0002 Apuseni, 46.630536°N, 22.601559°E, 530 m., 46.637640°N, 22.604392°E, 321 m., 04.06.2021, larvae under beech bark in temporary wind-felled wood depots.
- Peștiș, ROSAC0322 Muntele Șes, 47.105401°N, 22.404604°E, 325 m., 29.06.2021, larvae on *Tilia* sp. logs deposited on the river bank.

Arad County

- Pecica, Mănăstirea Bezdin, ROSAC0108 Lunca Mureșului Inferior, 46.1422585°N, 21.02336884°E, 99 m., 46.14111111°N, 21.02513889°E, 98 m., 46.14136111°N, 21.02019444°E, 98 m., 04.02.2023, 46.13894444°N, 21.05988889°E, 104 m., 22.04.2023, larvae.
- Sânpetru German, 46.12539301°N, 21.01151525°E, 95 m., 11.04.2023, larvae.
- Cenad, 46.15666492°N, 20.57010074°E, 87 m., 30.04.2023, larvae in oak wood.
- Zădăreni, 46.14838352°N, 21.19700432°E, 117 m., 04.22.2023, larvae.

Discussions

Rare and protected in too few Natura 2000 areas in Romania, we consider that the species has not received sufficient attention. Currently, except for the Iași area, the species is protected in Romania only in the montane and submontane areas. Both our observations and those from other sources reveal the distribution of the species in lower areas, especially in the forests along rivers. In the investigated areas, we found a higher frequency of the species along the valleys where logs are deposited on moist soil and develop a rich network of fungi under the bark. Regarding the preference for tree species, *C. cinnaberinus* was most frequently found in poplar followed by elm wood, acacia, willow, spruce, and oak. The species uses beech less, most likely due to the characteristics of its bark, where less moisture is retained and fewer fungi develop. However, we identified trunks with numerous larvae on fallen beech wood in an old forest within the ROSAC002 Apuseni, where the wood remained on the

ground in high humidity conditions for over a year. We did not find the species on hornbeam. As for the host tree species for *C. cinnaberinus*, not mentioned in the literature, we identified the species on walnut, *Juglans regia* (Visca, Hunedoara County) and elder, *Sambucus nigra* (Țațu, Caraș-Severin County) (Fig. 2). Vrezec et al. (2017) based on statistical data, concluded that the host tree, length, and diameter are the most important variables on which the presence of the species depends, with a higher preference for *Tilia, Populus*, and *Robinia*. In Țațu, larvae were identified on wood with a diameter of less than 10 cm, confirming that the species also uses wood with reduced diameter and age.

Recent sightings of the species open the way for further studies on inventorying the species in protected areas, designating new areas, especially in the plain area and paying greater attention to the role of poplar and acacia plantations. Our observations indicate for the first time the presence of the species in the Natura 2000 areas: ROSAC0355 Podișul Lipovei-Poiana Ruscă, ROSAC0126 Munții Țarcu, ROSAC0325 Munții Metaliferi, ROSAC0002 Apuseni, ROSAC0322 Muntele Șes, ROSAC0108 Lunca Mureșului Inferior.

Conclusions

Cucujus cinnabeinus was identified in several Natura 2000 areas, indicating the need for further studies on inventorying the species in protected areas, especially in the plain areas, and emphasizing the role of poplar and acacia plantations. These observations highlight the importance of expanding conservation efforts, understanding the species' habitat preferences, and conducting further studies to ensure the protection of *C. cinnaberinus* in Romania.

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